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THE GENUS SARCOSCYPHA IN CROATIA. ECOLOGICAL AND DISTRIBUTION PATTERNS

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Abstract

All species of the *Sarcoscypha coccinea* agg. (viz. *S. austriaca*, *S. coccinea*, *S. jurana* and *S. macaronesica*) hitherto known to occurr in Europe are listed, mapped and ecologically analyzed through records so far collected in Croatia. The ecological niches and substrate preferences are discussed and compared with results from other European special studies. Apothecial development and conidial behaviour of selected fructifications of *S. austriaca* is monitored from 1990 to 1992. *Sarcoscypha austriaca* and *S. coccinea* were already known for Croatia, while *S. macaronesica* and *S. jurana* are recorded as new for Croatia.

Key words: Ascomycota, Pezizales, *Sarcoscypha, S. austriaca, S. coccinea, S. jurana, S. macaronesica.* – biogeography, ecology, inventory and mapping. – mycobiota of Croatia.

INTRODUCTION

Both the occurence and high frequency of the hibernal-vernal genus *Sarcoscypha* in Croatia is long well-known, with the oldest known record published by SCHULZER (1857) as *Peziza coccinea* for which author states «winterlich, vom Dezember, seltner schon Ende Oktober bis März» and «nirgends selten». As a substrate he quotes rotten branches of *Quercus* sp., *Prunus spinosa* and *P. domestica*. The genus was later also recorded by VOUK & PEVALEK (1915), TORTIĆ (1966, 1968), FOCHT (1979) with all records determined as *S. coccinea* and TORTIĆ (1989) as *S. coccinea s. lat.* Subsequently, FOCHT (1986) briefly presented three species (*S. austriaca, S. coccinea* and *S. macaronesica*) with some general notes about their occurrence and substrate preferences for area of former Yugoslavia but without

any specifications on material or localities. Presently, it is not possible to decide on the species identity in all of these older records unless exsiccata were saved for microscopical revision. No special study of the genus in Croatia has been undertaken since BARAL (1984) showed reliable criteria for species delimitation. In his study he included seven exsiccata from Croatia collected in 60's and 70's of the 20th century by Milica Tortić and colleagues and he found that they include two species – *S. austriaca* and *S. coccinea s. str.* Thus, following a short article series that summarize the genus *Scutellinia* in Croatia (MATOČEC, ANTONIĆ, MRVOŠ 1995; MATOČEC 1998, 2000), we treat all known material of the genus *Sarcoscypha* in the national scale, which is presented in a similar way. In this paper we do not provide species descriptions as well as the concepts of their delimitation since they are already well described and delimited (BARAL 1984).

MATERIAAL AND METHODS

Fresh material collected during our long term research of discomycetous fungi was treated in the living state whenever possible, applying techniques described in BARAL (1992). Our remaining collections and the older dried specimens were taken into analysis subsequently. The preparation techniques follow earlier paper (MATOČEC, ANTONIĆ & MRVOŠ, 1995) except for the exsiccata cutting. Hand sections were prepared by vertical-median cutting of dried apothecia with the razor blade. Spores from the dried specimens were observed and measured rather in tap water than in KOH solution as the latter medium causes heavy spore shape distortion and wall layer loosening. Over 200 specimens collected from 1964 to the present date produced four closely related species that could be identified at best when in living state (cf. BARAL 1984). All bioclimatic belts in Croatia were covered with this research, ranging from continental lowland, montane and subalpine to the Mediterranean area. Few comparative collections from neighbouring regions are also included. In regional landscape units delimitation we follow RADOVIĆ (2000) with minor modifications. In the species concept we follow BARAL (1984). MTB grid with basic grid level is used for mapping. All exsiccata and recorded data are deposited in the CNF (Croatian National Fungarium). In order to reduce space, both the layout and citation of examined material data follow the mode presented in earlier paper (MATOČEC, KRISAI-GREILHUBER & SCHEUER, 2005).

Localities visited

1. Babin kuk area, Lapad peninsula, Dubrovnik (23.3.1981) - Southern Dalmatia, MTB 3374, 40 m s. m.; tall evergreen forest with *Quercus ilex, Laurus nobilis, Myrtus communis* etc.

2. Babin zub peak (452)-Sopotski slap, Mt. Medvednica (5.1.1998) - North-western Croatia, MTB 0161, 360 m s. m.; riparian forest of *Alnus glutinosa* and *Salix* spp.

3. Bedenik forest (Bjelovar) (25.11.1987) – Bilogorsko-Moslavačka region, MTB 0066, 130 m s. m.; broadleaved forest.

4. Berencebarati (Hont) (1.4.1996; 4.4.1996) – Hungary, lowland oak forest with common hornbeam with planted *Robinia pseudoacacia.*

5. Bliznec brook below Varoško rebro area, Mt. Medvednica (30.11.1982) – North-western Croatia, MTB 0161, 290 m s. m.; riparian forest of *Alnus glutinosa* and *Salix* spp.

6. Bračev vrh peak (608)-Veliki Kalnik castle, Mt. Kalnik (18.4.1987; 28.4.1987; 23.1.1988; 12.2.1989; 12.4.1993) – North-western Croatia, MTB 9864, 520-550 m s. m.; deciduous forest of *Quercus petraea, Fagus sylvatica, Carpinus betulus*, partly invaded by *Robinia pseudoacacia* from neighbouring plantations.

7. Braslovje (Rude), Samoborsko gorje range (16.2.1997) - Žumberak, MTB 0259, 400 m s. m.; mediterranoid deciduous shrub *Ostrya carpinifolia, Fraxinus ornus, Quercus dalechampii* and with *Erica carnea*.

8. Bregana river near Gabrovica, Žumberak range (8.2.1992) - Žumberak, MTB 0160, 200 m s. m.; riparian forest of *Alnus glutinosa* and *Salix* spp.

9. Brestovac area, Mt. Medvednica (17.12.2000) – North-western Croatia, MTB 0161, 790 m s. m.; mixed forest of *Abies alba, Fagus sylvatica* and *Acer pseudoplatanus.*

10. Brezakovec (Kumrovec) (24.2.2002; 23. 4.2005) - North-western Croatia, MTB 9959, 280 m s. m.; anthropogenous open habitat with planted *Picea abies, Robinia pseudoacacia* and *Sambucus nigra* shrubs.

11. Brezine forest (Križevci) (12.3.1988; 18.3.1988; 12.4.1993) – Bilogorsko-Moslavačka region, MTB 9965, 150 m s. m.; deciduous forest of *Quercus petraea, Carpinus betulus* and *Fagus sylvatica* with some *Robinia pseudoacacia* on its fringes.

12. Brezine forest-Potočak brook (Križevci) (7.2.1988) – Bilogorsko-Moslavačaka region, MTB 9965, 150 m s. m.; riparian forest of *Alnus glutinosa, Salix* spp. and *Populus* spp.

13. Bukovača forest near Končanica fishery (Daruvar) (4.4.1994) – Bilogorsko-Moslavačka region, MTB 0368, 150 m s. m.; *Salix alba* stand.

14. Bundek lake, Zagreb (1.4. 2001) – Posavina lowland, MTB 0261, 120 m s. m.; *Pinus nigra* and *P. sylverstris* plantations with *Robinia pseudoacacia* and *Sambucus nigra* shrubs.

15. Cer area, Mt. Medvednica (24.3.2002) – North-western Croatia, MTB 0062, 600 m s. m.; deciduous forest of *Fagus sylvatica.*

16. Daruvar (30.3.1966) – Bilogorsko-Moslavačka region, MTB 0469, 160 m s. m.

17. Dolje, Zagreb (22.2. 1992) – North-western Croatia, MTB 0161, 250 m s. m.; anthropogenous shrub habitat of *Robinia pseudoacacia* and *Sambucus nigra.*

18. Donja Dobra (Brod Moravice) (4.4. 1992) – Gorski kotar, MTB 0555, 450 m s. m.; riparian forest of *Alnus glutinosa, Salix* spp. with *Corylus avellana.*

19. Draše (Dubravica near Zaprešić) (3.4.1988) – North-western Croatia, MTB 9960, 170 m s. m.; deciduous forest of *Quercus robur* and *Carpinus betulus,* with inclusions of *Robinia pseudoacacia.*

20. Družanica area, Mt. Medvednica (23.1.1993) – North-western Croatia, MTB 0161, 430 m s. m.; degraded deciduous forest of *Carpinus betulus* and *Corylus avellana* with heavy inclusions of *Robinia pseudoacacia* and *Sambucus nigra.*

21. Dubočanka brook-middle part, Mt. Papuk (Velika) (31.3.2003) – Central Slavonia, MTB 0572, 350 m s. m.; montane braodleaved forest.

22. Glavica area, Mt. Medvednica (31.3.1996) – North-western Croatia, MTB 0161, 440 m s. m.; degraded deciduous forest of *Quercus petraea, Fagus sylvatica, Carpinus betulus* with inclusions of *Robinia pseudoacacia* and *Sambucus nigra.*

23. Gomirje (7.4.2000) – Gorski kotar, MTB 0656, 350 m s. m.; deciduous forest of *Alnus glutionsa, Carpinus betulus* with *Sambucus nigra.*

24. Gorica forest (Gomirje) (17.11.1996; 5.4.1997; 31.10.1999) – Gorski kotar, MTB

0656, 430 m s. m.; mixed forest of *Abies alba* and *Fagus sylvatica* with *Picea abies.*

25. Gornja Bistra-Kraljev Vrh (1.4. 2004) – North-western Croatia, MTB 0061, 250 m s. m.; deciduous forest of *Quercus petraea, Carpinus betulus* and *Fagus sylvatica* strongly degraded throughout, thus with high portions of *Corylus avellana, Robinia pseudoacacia, Sambucus nigra* and *Pinus sylvestris.*

26. Gornji Stenjevec-Veternica cave, Mt. Medvednica (17.3.1991; 23.1.1993; 3.2.2001; 9.3.2002) - North-western Croatia, MTB 0161, 220-300 m s. m., degraded deciduous forest of *Carpinus betulus, Corylus avellana, Cornus sanguinea*, interspersed with *Robinia pseudoacacia* and *Sambucus nigra.*

27. Goršćica area, Mt. Medvednica (19.4.1992) – North-western Croatia, MTB 0062, 700 m s. m.

28. Gračani, Zagreb (30. 11. 1982) - North-western Croatia, MTB 0161, 240-290 m s. m.; orchards and grasslands with *Prunus domestica, Cornus sanguinea* and *Robinia pseudoacacia.*

29. Gradac Požeški (Požega) (31.3.2002) - Central Slavonia, MTB 0672, 130 m s. m., deciduous forest of *Quercus robur, Ulmus minor, Carpinus betulus, Corylus avellana* and *Acer campestre.*

30. Gradina area-Vincek (Repaš) (10.1.1999) – Podravina lowland, MTB 9868, 120 m s. m., flood forest of *Quercus robur* and *Fraxinus angustifolia* with *Ulmus minor.*

31. Grubišno Polje (25.2.1995; 3.3.1996) - Bilogorsko-Moslavačka region, MTB 0269, 160 m s. m.; orchard with *Robinia pseudoacacia* and coniferous plantation.

32. Grubišno Polje-Šovarnica brook (24.12.1995) - Bilogorsko-Moslavačka region, MTB 0269, 160 m s. m.; remnants of riparian vegetation of *Alnus glutinosa* with *Robinia pseudoacacia* inclusions.

33. Gvozdeni-Topli brook (Ljubošina, Gomirje) (22.2.1997) - Gorski kotar, MTB 0657, 410 m s. m.; deciduous forest of *Fagus sylvatica* and *Corylus avellana.*

34. Idrija area (2.4.1967) - Slovenia (type locality of *Peziza coccinea*).

35. Ilovica area (Ravna Gora), Mt. Velika Kapela (2.5. 2004) – Gorski kotar, MTB 0655, 820 m s. m.; mixed forest of *Abies alba, Fagus sylvatica, Picea abies* and *Acer pseudoplatanus.*

36. Izimje (Jastrebarsko) (18.3.2001; 1.4.2001) – Posavina lowland, MTB 0359, 140 m s. m.; deciduous forest of *Quercus robur* partly changed into *Picea abies* and *Larix decidua* plantations interspersed with *Robinia pseudoacacia* and *Sambucus nigra.*

37. Jagerov kut area (Ždala) (11.1.1999) – Podravina lowland, MTB 9869, 110 m s. m.; flood forest of *Fraxinus angustifolia, Frangula alnus, Ulmus minor, Alnus incana, A. glutinosa* with *Sambucus nigra.*

38. Jambrišakovo vrelo spring (Ponikve area), Mt. Medvednica (31.1.1996; 9.3.1997) – North-western Croatia, MTB 0161, 480 m s. m.; riparian forest of *Alnus glutinosa, Salix* spp. with inclusions of *Robinia pseudoacacia.*

39. Jambrišakovo vrelo spring-Podbjelka area, Mt. Medvednica (21.4.1996) - North-western Croatia, MTB 0161, 510 m s. m.; forest of *Alnus glutinosa, Carpinus betulus* with inclusions of *Robinia pseudoacacia.*

40. Jarun lake-Sava river, Zagreb (12.3.1979) – Posavina lowland, MTB 0261, 120 m s. m.; tall riparian forest of *Populus alba* and *Salix* spp.

41. Javorek brook-Cerinski vir fall, Samoborsko gorje range (7.1.1998) - Žumberak, MTB 0259, 340 m s. m. ; *Alnus glutinosa* streamside in the forest of *Fagus sylvatica, Carpinus*

betulus and *Acer obtusatum.*

42. Jazavica area (Grubišno Polje) (21.1.1995) – Bilogorsko-Moslavačka region, MTB 0269, 160 m s. m., remnants of riparian *Alnus glutinosa* stand with many *Robinia pseudoacacia* and *Sambucus nigra.*

43. Jelenovac park, Zagreb (3.2.1992; 27.3.2007) – North-western Croatia, MTB 0161, 150-180 m s. m., deciduous forest of *Quercus petraea, Carpinus betulus, Fagus sylvatica, Prunus avium* interspersed with *Robinia pseudoacacia* and *Sambucus nigra.*

44. Ježdovec (Zagreb) (1.4.1990) – Posavina lowland, MTB 0261, 120 m s. m.; *Pinus plantation* with extensive inclusions of *Robinia pseudoacacia.*

45. Kalnička greda area, Mt. Kalnik (6.12.1987) – North-western Croatia, MTB 9865, 480 m s. m.; deciduous forest of *Fagus sylvatica, Quercus petraea* and *Carpinus betulus.*

46. Kalnik mountain hut, Mt. Kalnik (5.4.1987) – North-western Croatia, MTB 9864, 480 m s. m.; deciduous forest of *Quercus petraea* and *Carpinus betulus.*

47. Kamačnik brook-Kamačnik house (Vrbovsko) (1.11.1996; 16.11.1996) – Gorski kotar, MTB 0656, 400-410 m s. m.; deciduous forest of *Fagus sylvatica, Acer pseudoplatanus, Carpinus betulus* and *Corylus avellana.*

48. Kamanje-Kupa river (Ozalj) (16.2.1997) – Plateau of Kordun and Pokuplje, MTB 0358, 160 m s. m.; forest remnants of *Carpinus betulus* and *Corylus avellana* with *Robinia pseudoacacia* plantation.

49. Kamenica brook-Galezova Draga (Vivodina) (16.2.1997) - Žumberak, MTB 0358, 150-160 m s. m.; riparian forest of *Alnus glutinosa* and *Salix* sp. sporadically invaded by *Robinia pseudoacacia* and *Sambucus nigra.*

50. Kamenica brook-Dvorišće Vivodinsko (Vivodina) (16.2.1997) - Žumberak, MTB 0358, 180 m s. m.; *Robinia pseudoacacia* and *Sambucus nigra* shrubs.

51. Kamenica brook-Kamanje (Ozalj) (16.2.1997) - Žumberak, MTB 0358, 150 m s. m.; riparian forest of *Alnus glutinosa, Corylus avellana* with *Robinia pseudoacacia* inclusions.

52. Kočje area (Brdo, Žrnovo), Korčula island (11.4.2003) – Southern Dalmatia, MTB 3068, 180 m. s. m., tall humid evergreen forest of *Quercus* spp., *Laurus nobilis, Phyllirea spp., Viburnum* spp. and *Myrtus communis.*

53. Kolarska gora area, Mt. Medvednica (19.2.1995) – North-western Croatia, MTB 0161, 460 m s. m.; broadleaved forest.

54. Kolenka forest-Velika brook (Tkalec near Vrbovec) (20.3.1988) – Bilogorsko-Moslavačka region, MTB 0064, 150 m s. m.; *Alnus glutinosa* and *Salix* spp. streamside forest.

55. Končanica (Daruvar) (4.4.1994) – Bilogorsko-Moslavačka region, MTB 0368, 150 m s. m.; *Robinia pseudoacacia* and conifer plantation.

56. Koravac brook (Greda Sunjska near Sunja) (8.2.2004) – Posavina lowland, MTB 0665, 100 m s. m.; remnants of tall riparian forest of *Fraxinus anfustifolia, Populus alba* and *Salix* spp.

57. Koruška brook, Križevci (2.4.1988) – Bilogorsko-Moslavačka region, MTB 9965, 120 m s. m.; *Robinia pseudoacacia* plantation.

58. Kosica area-Korita area (Vrbovsko) (2.5.2004) – Gorski kotar, MTB 0556, 640-650 m s. m.; mixed forest of *Abies alba, Fagus sylvatica, Picea abies* and *Acer pseudoplatanus* with *Corylus avellana.*

59. Križevci (2.3.1990) – Bilogorsko-Moslavačka region, MTB 9965, 160 m s. m.; deciduous forest of *Alnus glutinosa, Populus* sp., *Carpinus betulus* and *Quercus robur.*

60. Križna gorica peak (428), Mt. Medvednica (12.3.1995) – North-western Croatia, MTB 0062, 400 m s. m.; *Robinia pseudoacacia* shrubs.

61. Kupčina springs, Žumberak range (28.2.1998) - Žumberak, MTB 0258, 280 m s. m.; deciduous forest of *Fagus sylvatica, Corylus colurna, Acer obtusatum* with *Sambucus nigra.*

62. Kupčina river-Sopotski slap fall, Žumberak range (28.2.1998) - Žumberak, MTB 0258, 610 m s. m.; *Fagus sylvatica, Ostrya carpinifolia* and *Salix* sp.

63. Lonjščina brook, Mt. Medvednica (21.2.1992; 8.3.1992) – North-western Croatia, MTB 0161, 300-320 m s. m.; deciduous forest of *Quercus petraea, Carpinus betulus* and *Fagus sylvatica* with its border settled with *Robinia pseudoacacia* and *Sambucus nigra.*

64. Lubeničica brook-Goli vrh peak (529), Mt. Medvednica (25.2.1996) – North-western Croatia, MTB 0161, 400 m s. m.; deciduous forest of *Fagus sylvatica, Quercus petraea, Carpinus betulus*, with *Corylus avellana.*

65. Špiranečki lug forest (Križevci) (25.3.1988) – Bilogorsko-Moslavačka region, MTB 0065, 115 m. s. m.; riparian forest of *Alnus glutinosa* and *Salix* spp., with several substands of *Robinia pseudoacacia* and *Sambucus nigra.*

66. Lukšići, Zagreb (6.2.1979; 9.2.2002) – North-western Croatia, MTB 0161, 260 m s. m.; *Robinia pseudoacacia* and *Cornus sanguinea* shrubs.

67. Mače (Zlatar) (1.5.1985) – North-western Croatia, MTB 9962, 240 m s. m.

68. Mačkov kamen area, Mt. Medvednica (12.3.1995) – North-western Croatia, MTB
100 0062, 560 m s. m., deciduous forest of *Fagus sylvatica, Tilia platyphyllos* and *Fraxinus ornus.*

69. Markovec brook, Mt. Medvednica (8.10.1995) – North-western Croatia, MTB 0161, 280 m s. m.; deciduous forest of *Quercus petraea, Castanea sativa, Carpinus betulus* with *Acer pseudoplatanus* and *Fraxinus excelsior.*

70. Martinšćak peak (346) (Duga Resa) (1.3.1997) – Plateau of Kordun with Pokuplje, MTB 0559, 340 m s. m.; grassland with few *Tilia* sp. trees and *Robinia pseudoacacia* shrubs.

71. Medveščak brook below Medvedgrad castle, Mt. Medvednica (12.3.1989; 16.3.1992) – North-western Croatia, MTB 0161, 420 m s. m.; riparian forest of *Alnus glutinosa* with *Sambucus nigra* in the forest of *Quercus petraea, Carpinus betulus, Fagus sylvatica* and *Acer pseudoplatanus.*

72. Medveščak brook at Kraljičin Zdenac mountain hut, Mt. Medvednica (16.3.1992) - North-western Croatia, MTB 0161, 520 m s. m.; deciduous forest of *Quercus petraea, Carpinus betulus, Fagus sylvatica* and *Acer pseudoplatanus* with *Sambucus nigra.*

73. Meglinec (Dugo Selo) (12.4. 1980) – North-western Croatia, MTB 0163, 110 m s. m.; *Robinia pseudoacacia* plantation.

74. Mihaljevac, Zagreb (21.2.1992) – North-western Croatia, MTB 0161, 190 m s. m.; *Robinia pseudoacacia* and *Sambucus nigra* shrubs.

75. Mikulići, Zagreb (12.4.1964; 2.2.1985; 10.3.1985; 23.2.2002) – North-western Croatia, MTB 0161, 280 m s. m.; deciduous forest of *Fagus sylvatica, Quercus petraea* with planted *Pinus sylvestris* and *P. nigra* interspersed with *Robinia pseudoacacia.*

76. Mikulići-Lukšići, Zagreb (30.1. 1985) – North-western Croatia, MTB 0161, 260 m s. m.

77. Mikulićka gora area., Mt. Medvednica (15.2. 1992; 15.3.1992; 14.3.1993; 9.3.2003) – North-western Croatia, MTB 0161, 310-380 m s. m.; deciduous forest of *Quercus petraea,*

Castanea sativa, Carpinus betulus with *Corylus avellana* and planted *Pinus sylvestris* and *P. nigra* inetrspersed with *Robinia pseudoacacia.*

78. Mirića-štropina area-Rječica brook (Plitvički Ljeskovac), Mt. Mala kapela (28.4.1976) - Lika, MTB 1159, 600 m s. m.; mixed forest of *Abies alba* and *Fagus sylvatica.*

79. Mišarica area (Milna), Brač island (5.12.2002) – Central Dalmatia, MTB 2665, 400 m s. m.; evergreen tall forest of *Quercus ilex, Pinus halepensis, Phyllirea* spp., *Laurus nobilis* and *Myrtus communis.*

80. Novo Čiče (Velika Gorica) (8.3.2003) – Posavina lowland, MTB 0262, 100 m s. m.; flood forest of *Fraxinus angustifolia, Ulmus minor, Alnus glutinosa* and *Salix* spp.

81. Novo Selo (Selca), Brač island (1.4.2005) – Central Dalmatia, MTB 2667, 200 m s. m.; evergreen *Quercus ilex* and *Pinus halepensis* forest.

82. Novoselčina forest, Sesvete, Zagreb (25.2.1980) – North-western Croatia, MTB 0162, 160 m s. m.; deciduous forest of *Quercus petraea* and *Carpinus betulus.*

83. Obrašina forest (Grubišno Polje) (18.12.1994; 12.11.1995) – Bilogorsko-Moslavačka region, MTB 0269, 160 m s. m.; deciduous forest of *Quercus petraea, Fagus sylvatica, Prunus avium* and *Carpinus betulus* heavily invaded by *Robinia pseudoacacia.*

84. Obrovi forest (Grubišno Polje) (11.2.1995) – Bilogorsko-Moslavačka region, MTB 0269, 180 m s. m.; deciduous forest of *Quercus petraea, Fagus sylvatica, Prunus avium, Carpinus betulus* and *Acer platanoides,* completely without *Robinia pseudoacacia.*

85. Osoje area (Plemenitaš near Lukovdol) (14.10.2002) – Gorski kotar, MTB 0556, 460 m s. m.; deciduous forest of *Fagus sylvatica, Fraxinus excelsior, Acer pseudoplatanus* and *A. campestre.*

86. Oštrica area, Mt. Medvednica (24.4.1966) – North-western Croatia, MTB 0061, 800 m s. m.; deciduous forest of *Acer pseudoplatanus, Fraxinus excelsior* and *Fagus sylvatica.*

87. Otok-Podbrest (Prelog) (30.4.1984; 9.2.2002; 23.3.2006) – Međimurje, MTB 9665, 150 m s. m.; flood forest of *Fraxinus angustifolia, Alnus incana, A. glutinosa, Salix* spp. sporadically settled with *Robinia pseudoacacia* and *Sambucus nigra.*

88. Pesek, Križevci (20.12.1987) – Bilogorsko-Moslavačka region, MTB 9965, 180 m s. m.; *Picea abies* and *Pinus strobus* plantation with some broadleaved trees.

89. Petrov grob area, Gomirska kosa area, Mt. Velika kapela (8.4. 2007) – Gorski kotar, MTB 0656, 680 m s. m.; mixed forest of *Abies alba* and *Fagus sylvatica.*

90. Pleterje (Šentjernej) (29.3.1970) - Slovenia.

91. Podbjelka area, Mt. Medvednica (21.4.1996; 25.1.2002) – North-western Croatia, MTB 0161, 520-570 m. s. m.; deciduous forest of *Quercus petraea., Fagus sylvatica, Carpinus betulus, Acer pseudoplatanus, A. campestre* with minor inclusions of *Robinia pseudoacacia.*

92. Podravska Subotica (17.1.1993) – Podravina lowland, MTB 9866, 180 m s. m.

93. Ponikve area, Mt. Medvednica (31.3.1996) – North-western Croatia, MTB 0161, 470 m s. m.; *Alnus glutinosa* streamside forest.

94. Prud area (Strmec near Samobor) (8.4.1988) – Posavina lowland, MTB 0160, 120 m s. m.; flood forest of Fraxinus angustifolia, *Quercus robur, Alnus glutinosa, Salix alba* and *Frangula alnus.*

95. Reka (Koprivnica) (4.5.1971) – Bilogorsko-Moslavačka region, MTB 9866, 160 m s. m.; *Robinia pseudoacacia* plantation.

96. Ribnica (Velika Gorica) (16.3.2003) – Posavina lowland, MTB 0262, 100 m s. m.; flood forest of *Fraxinus angustifolia, Alnus glutinosa* and *Salix* spp. with *Sambucus nigra.*

97. Ribnjak brook-Polovine, Gomirje (4.5.2004) – Gorski kotar, MTB 0656, 360 m s. m.; *Pinus strobus* and *Pseudotsuga menziesii* plantation with *Sambucus nigra.*

98. Risje area (Sesvetski Kraljevec near Zagreb) (12.3.2000) – North-western Croatia, MTB 0163, 130 m s. m.; *Robinia pseudoacacia* plantation with *Sambucus nigra* in deciduous forest of *Quercus robur, Carpinus betulus, Prunus avium, Populus* sp. and *Corylus avellana.*

99. Risnjak mountain hut, Mt. Risnjak (2.5. 1964) – Gorski kotar, MTB 0553, 1400 m s. m.; subalpine forest of *Fagus sylvatica.*

100. Rog peak (748), Mt. Medvednica (12.3.1995) – North-western Croatia, MTB 0062, 720 m s. m.; mixed forest of *Fagus sylvatica, Sorbus aria, Tilia platyphyllos, Taxus baccata* with *Corylus avellana.*

101. Rogatnica brook-Gorca (Ptuj) (20.3.1996) - Slovenia, 230 m s. m.; riparian vegetation of *Alnus glutinosa.*

102. Rudarska gradna brook-Lampov breg peak (522), Samoborsko gorje range (6.1. 2001) - Žumberak, MTB 0260, 210 m s. m.; degraded deciduous forest of *Carpinus betulus, Cornus sanguinea* and *Sambucus nigra.*

103. Sava river-Puska (Jasenovac) (2.3.2002) – Posavina lowland, MTB 0666, 90 m s. m.; riparian stand of *Salix* sp. with *Phragmites communis* invaded by *Amorpha fruticosa.*

104. Sava river-Petruševec, Zagreb (28.2.1983) – Posavina lowland, MTB 0262, 100 m. s. m., light riparian forest of *Populus alba, Salix* spp. and *Fraxinus angustifolia* with *Corylus* shrubs.

105. Sava river-Mičevec (Zagreb) (23.3.2002) – Posavina lowland, MTB 0262, 100 m s. m.; flood forest.

102 **106. Sava river-Prud area (Podsused, Zagreb)** (22.3. 1997; 28.3.1997; 11.3.1998) – Posavina lowland, MTB 0160, 120 m s. m.; neophyte vegetation of *Helianthus tuberosus, Robinia pseudoacacia* with *Sambucus nigra.*

107. Schaffhausen (20.2.1987) - Switzerland, locality with comparative material of *S. jurana.*

108. Selca, Brač island (5.12.2002) – Central Dalmatia, MTB 2767, 180 m s. m.; evergreen forest of *Quercus ilex, Arbutus unedo, Myrtus communis* and *Fraxinus ornus.*

109. Sesvete, Zagreb (17.2.1980) – North-western Croatia, MTB 0162, 130 m s. m.; *Robinia pseudoacacia* plantation.

110. Sesvetski Kraljevec (Sesvete, Zagreb) (16.3.1980; 29.3.1980; 4.4.1984; 26.3.1985; 25.4.1986; 15.3.1989; 25.3.1990; 23.2.2002; 9.3.2002) – North-western Croatia, MTB 0163, 130-140 m. s. m., broadleaved forest remnant with a lot of *Robinia pseudoacacia* and *Sambucus nigra.*

111. Slugovine brook (Krušljevec near Beletinec) (16.3.2003) – North-western Croatia, MTB 9764, 190 m s. m.; deciduous forest of *Quercus petraea, Acer* sp. with *Betula pendula.*

112. Srebrnjak, Zagreb (26.1.2003) – North-western Croatia, MTB 0161, 180 m s. m.; old orchard.

113. Sudovčina (Ludbreg) (5.4.1987) – Podravina lowland, MTB 9765, 160 m s. m.; *Robinia pseudoacacia* plantation with *Sambucus nigra.*

114. Sukorova poljana area (Vrbovsko) (10.4.2004) – Gorski kotar, MTB 0656, 430 m s. m.; mixed forest fringe with *Carpinus betulus, Juniperus communis, Corylus avellana* and *Prunus avium* stand.

115. Suvača forest-Šetnik brook (Cvetnić Brdo) (28.2.1997) – Posavina lowland, MTB 0461, 150 m s. m.; deciduous forest of *Quercus petraea, Carpinus betulus* and *Populus*

tremula with *Betula pendula.*

116. Sv. Ilija church-Isine brook (Jezernice), Žumberak range (21.2.1998) - Žumberak, MTB 0258, 680 m s. m.; riparian forest of *Salix* spp. with *Prunus avium* and *Sambucus nigra.*

117. Svi Sveti church (Gornji Humac), Brač island (7.12.2002) – Central Dalmatia, MTB 2766, 360 m. s. m.; tall evergreen forest of *Quercus ilex, Laurus nobilis* and *Fraxinus ornus.*

118. Šestinski Dol, Črnomerec, Zagreb (6.1.-22.4.1992) – North-western Croatia, MTB 0161, 170 m s. m.; *Robinia pseudoacacia, Sambucus nigra, Corylus avellana* and *Cornus sanguinea* shrubs – monitored plot.

119. Mt. Klekovača (22.5.1970) – Bosnia-Herzegovina, 1400 m s. m.; mixed forest of *Abies alba* and *Fagus sylvatica.*

120. Šimunov grad area (Mirkovica peak, 1286), Mt. Velika kapela (18.5.1996; 25.5.1996; 15.5.1999) – Gorski kotar, MTB 0756, 1100 m s. m.; mixed forest of *Picea abies, Sorbus aucuparia, Acer pseudoplatanus, Oreoherzogia fallax* and *Ribes alpinum.*

121. Široko brezje forest (Križevci) (15.3.1987; 18.3.1988; 19.3.1989) – Bilogorsko-Moslavačka region, MTB 9965, 160 m s. m.; deciduous forest of *Quercus robur, Alnus glutinosa* and *Carpinus betulus* with some inclusions of *Robinia pseudoacacia.*

122. Štvanja area (Repaš) (15.1.1999) – Podravina lowland, MTB 9868, 120 m s. m.; flood forest of *Quercus robur, Alnus glutinosa* and *Frangula alnus.*

123. Štvanja area-Cenkovcan (Repaš) (15.1.1999) - Podravina lowland, MTB 9868, 120 m s. m.; flood forest of *Fraxinus angustifolia, Quercus robur* and *Acer campestre* with *Sambucus nigra.*

124. Tepice area (Mirkovica peak 1286), Mt. Velika kapela (30.4.1994) – Gorski kotar, MTB 0756, 990 m s. m.; deciduous forest of *Fagus sylvatica, Acer pseudoplatanus* and *Fraxinus excelsior.*

125. Teškovec peak (463), Mt. Medvednica (21.11.1989) – North western Croatia, MTB 0161, 410 m s. m.; degraded deciduous forest without *Robinia pseudoacacia.*

126. Točak spring, Grubišno Polje (24.1.1995; 31.3.1996) - Bilogorsko-Moslavačka region, MTB 0269, 160 m s. m.; riparian stand of *Alnus glutinosa* with *Robinia pseudoacacia* plantation.

127. Tugonica (Marija Bistrica) (23.3. 2002) – North-western Croatia, MTB 9962, 150 m s. m.; deciduous forest of *Quercus petraea, Carpinus betulus* and *Fagus sylvatica.*

128. Turopoljski lug forest (Lekenik) (23.3.1993) – Posavina lowland, MTB 0363, 100 m s. m.; flood forest of *Fraxinus angustifolia, Alnus glutinosa* and *Quercus robur.*

129. Tuškanac park, Zagreb (12.2.1992; 15.2.1995) – North-western Croatia, MTB 0161, 140 m s. m.; city park with deciduous trees.

130. Varoško rebro area, Mt. Medvednica (26.1. 1980; 3.3.2002) – North-western Croatia, MTB 0161, 380-400 m s. m.; broadleaved forest of *Quercus petraea, Carpinus betulus*, partly invaded with *Robinia pseudoacacia.*

131. Velika lokva area (Mirkovica peak 1286), Mt. Velika kapela (30.4.1994) – Gorski kotar, MTB 0656, 1000 m s. m.; deciduous forest of *Fagus sylvatica, Acer pseudoplatanus, Sorbus aucuparia* and *Oreoherzogia fallax.*

132. Velika peč peak (667), Mt. Medvednica (12.3.1995) – North-western Croatia, MTB 0062, 640 m s. m.; deciduous forest of *Fagus sylvatica, Sorbus aria, Tilia platyphyllos* with *Corylus avellana.*

133. Veliki dol area (Rude), Samoborsko gorje range (27.2.1966) - Žumberak, MTB 0260, 400 m s. m.

134. Veli drmun area (Glavotok near Malinska), Krk island (13.3.2004) - Kvarner, MTB 0952, 50 m s. m.; thermophilic mixed forest of *Quercus pubescens, Fraxinus ornus, Carpinus orientalis, Quercus ilex* and *Phyllirea* sp.

135. Veliki Kalnik castle, Mt. Kalnik (18.4. 1987) – North-western Croatia, MTB 9864, 480 m s. m.; *Robinia pseudoacacia* plantation.

136. Veliki Pažut area (Kotoriba) (16.4.2000) - Međimurje, MTB 9667, 130 m s. m.; tall riparian forest of *Populus nigra, Alnus incana, A. glutinosa, Salix* spp. with *Cornus sanguinea* and *Sambucus nigra.*

137. Veliki potok brook, Mt. Medvednica (14.3.1993) – North-western Croatia, MTB 0161, 330 m s. m.; riparian forest of *Alnus glutinosa* and *Salix* spp.

138. Vinica peak (321) (Duga Resa) (1.3.1997) – Plateau of Kordun and Pokuplje, MTB 0559, 320 m s. m.; deciduous forest of *Quercus dalechampii, Carpinus betulus, Fraxinus ornus Populus tremula* and *Betula pendula* with *Sambucus nigra.*

139. Vinogradski put area-Januševec castle (Brdovec near Zaprešić) (3.4.2004) – North-western Croatia, MTB 0160, 180 m s. m.; degraded deciduous forest with high amount of *Robinia pseudoacacia* and *Sambucus nigra.*

140. Vranilec peak (643), Mt. Kalnik (1.3.1987; 17.1.1988; 3.2.1990) – North-western Croatia, MTB 9864, 520-560 m s. m.; rocky steep slopes much covered with *Robinia pseudoacacia.*

104 **141. Wenisbucherstraße-Himmelreichweg, Mariatrost, Graz** (14.12.2003) - Austria, GR./QU.: 8858/4, 450-480 m s. m.; wooded ravine with *Quercus sp., Carpinus betulus, Acer pseudoplatanus, Fraxinus excelsior* with *Prunus avium.*

ABBREVIATIONS OF PERSONS WHO TREATED AND/OR COLLECTED THE MATERIAL

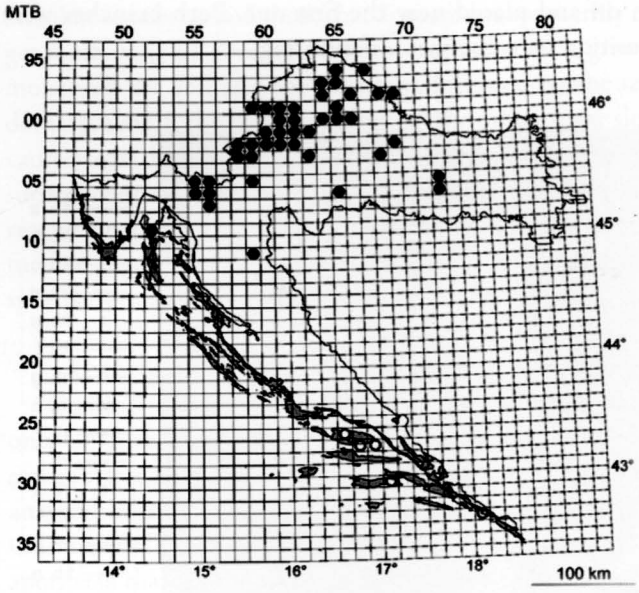
HOB - Hans-Otto Baral, A.B. – Ana Barešić, V.B. – Vera Burić, M.C. – Marijo Carević, M.Č. – Milan Čerkez, Lj.Đ. – Ljubinko Đurić, I.F. – Ivan Focht, S.G. – Sanja Gottstein, Ž.G. – Željko Gottstein, S.H. – Stana Hočevar, E.K. - Eduard Kletečki, I.K. – Ivana Kušan, N.M. – Neven Matočec, A.M. – Armin Mešić, S.M. – Sanja Meštrović, D.M. – Dušan Mrvoš, T.P. – Tatjana Parađiković, M.S. – Miroslav Samardžić, C.S. – Christian Scheuer, V.S. – Vid Strpić, A.S. – Ana Salopek, Č.Š. - Čedomil Šilić, A.Š. – Aiša Špiček, Đ.T. – Đurđica Tkalčec, Z.T. – Zdenko Tkalčec, M.T. – Milica Tortić, S.T. – Stjepan Tortić, H.V. – Hrvoje Vranko

RESULTS

Sarcoscypha austriaca (Beck ex Sacc.) Boud.

OCCURENCE AND DISTRIBUTION

This species is most frequent of all treated species and is very widely distributed. In Croatia it is spread from Mediterranean thermophilic deciduous forests through almost all major habitat forest types of continental planar and colline zones to the highest forest stands in subalpine zone. However, the species has relatively sharp two distribution peaks, one situated in the lowland forests and plantations rich in *Alnus* and *Salix* species as well as with *Robinia*



Map 1 Known distribution of *S. austriaca* (filled cicles) and *S. macaronesica* (empty circles) in Croatia. Evergreen and mixed evergeen/deciduous vegetation zone is shaded in grey colour.

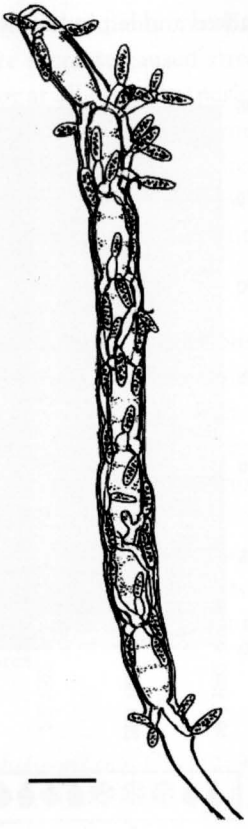


Fig. 1 (right) Ascus in *S. austriaca* ruptured by secondary spores (mitospores) richly produced on germinated submature ascospores while still in asci (CNF 2/1222). Horizontal bar = 20μm.

Additionally, there are a number of tree species revealed as apparently new hosts for *S. austriaca* (Fig. 7) some of which are of particular interest: (1) lowland areas - *Sambucus nigra* (one of the species dominant substrata), *Picea abies* (repeatedly found in several *Picea abies* plantations) and *Cornus sanguinea*; (2) montane areas – *Sorbus aucuparia* and *Oreoherzogia fallax*. There are few other hosts known but are apparently insignificant due to their low frequency (single collections).

Notes

I - Monitoring apothecial development

The monitoring of the apothecial development in natural conditions was performed at one occasion. The monitoring plot approx. 10 × 5 m was selected in autumn 1990 in a part of Zagreb situated on hilly slopes of Mt. Medvednica, at the steep eastern slope, 170 m s. m. (Loc. 118). It consists of dense, shady thicket of *Robinia pseudoacacia*, *Corylus avellana*, *Sambucus nigra* and *Cornus sanguinea* shrubs. This particular site is continuously settled with *Sarcoscypha austriaca*, with apothecia repeatedly recorded there for few preceding years colonizing fallen branches of both *Robinia pseudoacacia* and *Sambucus nigra*. At the end of October 1990, a 20 mm thick *Robinia* branch with its leaves still attached was found as recently fallen on the ground. At the same time one living Robinia branch of the same

thickness was deliberately broken off and placed near the first one. Both branches were marked and left in their original position for subsequent monitoring.

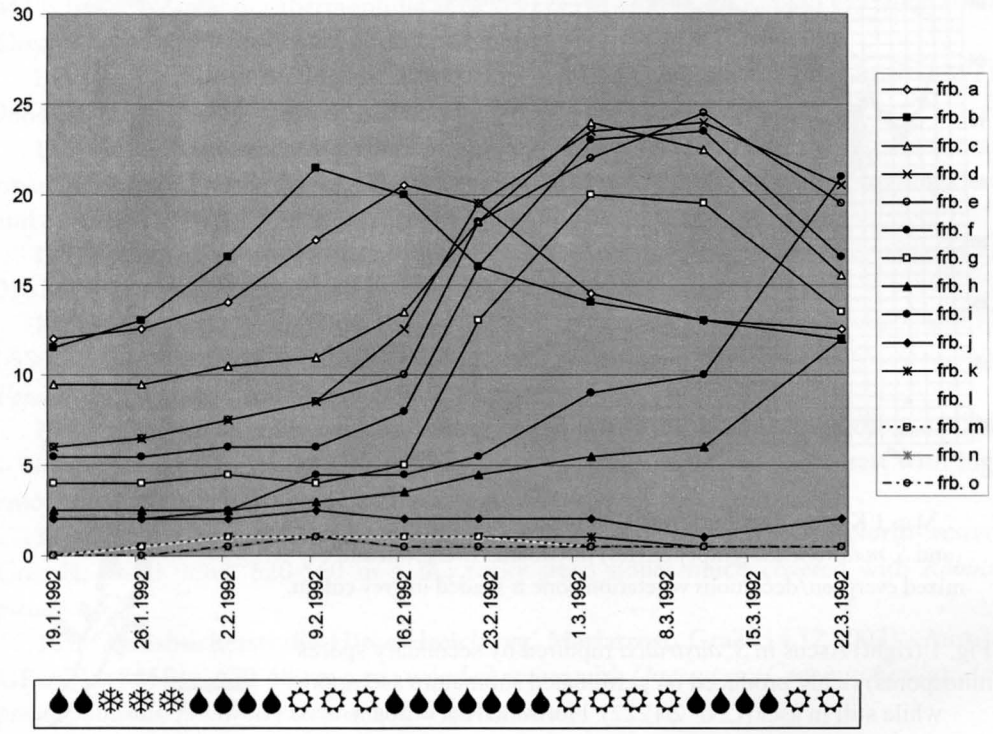


Fig. 2 monitoring the apothecial development in *Sarcoscypha austriaca*. Apothecial diameter (in milimetres) is shown by y-axis. Freezing, wet and dry substrate conditions are presented with the appropriate symbols at the bottom of the table.

Next year during January and February, and later during November and December, no apothecia were found on these branches. First few apothecial primordia were recorded in the beginning of January 1992 after partial snowmelt but only on a spontaneously fallen branch, at that time slightly immersed in the soil by its one end. Deliberately broken branch stayed without apothecia. Both branches were partially covered with thin *Corylus* litter. Shortly after, branches were strongly moistened after heavy rain in the mid January and ice crystals were found only on the undersides of the fallen leaves. The charting of the fructification and first apothecial measurements were taken on January 19th and the procedure was repeated in every 6-8 days afterwards. Few centimeters thick, continuous snow bed appeared again from January 22th and lasted to January 30th. Dry conditions prevailed between of 8th and 12th of February followed by new rain in mid February. A week of strong dry period occured from the beginning of March, with a new rain followed afterwards.

The monitoring performed in 1992 on apothecial development of selected fructification is shown on Fig. 2. It is obvious that apothecia of the monitored fructification has reached peaks of their development three times in three groups of fruitbodies (a & b; c-g and h & i).

Smallest apothecia and those that appeared subsequently never had opportunity to grow and get matured (j-o). During snow coverage apothecia grew negligible. Subsequent snowmelt moistured the soil and the substrate, followed by the temperature increase caused strong development in the largest apothecia. The others grew slowly or not at all. Two dry periods caused total drying of the smallest apothecia, while those that undergone rapid development succeeded to reach maturity but their apothecia usually cracked at the margin. All apothecia reached maturity at apothecial diameter of 18 mm or above at which point they stopped with further growth and usually started with intensive sporulation in approx. 24 hours. Entire sporulation period lasted at least for 3-5 days.

II – «Short» mitosporogenesis as apothecial respond to sudden dry conditions

Contrary to the closely related *S. coccinea* which produce mitospores (sympoduloconidia) only on mycelium (cf. BARAL 1984), *S. austriaca* may produce mitospores directly on ascospores, even while still in closed asci (Fig. 1). We can regard such behaviour as shortened anamorphosis. In this way the species surely can quickly adapt to abrupt dry conditions. Our material repeatedly displayed this feature especially in collections containing immature apothecia that stopped with growth due to sudden dry conditions appeared in long, warm and dry periods during winter. Such apothecia, still with strongly inrolled margin were frequently found dusted with white powder. All analyses of such apothecia showed that this powder was a mass of developed and partly released secondary spores.

SPECIMENS EXAMINED

Loc. 2, on *Salix* sp. (two records), *det.* N.M.; **Loc. 3**, on *Corylus avellana*, CNF 2/992, leg. S.M., *det.* N.M. & I.K.; **Loc. 4,** on *Robinia pseudoacacia*, CNF 2/3030, 3031, leg. E.K., *det.* N.M. & I.K.; **Loc. 5,** on *Alnus glutinosa*, no voucher, *leg.* & *det.* I.F., *rev.* N.M.; **Loc. 6,** on *Robinia pseudoacacia* three records without voucher, *det.* N.M.; **Loc. 10**, on *Sambucus nigra*, CNF 2/7394, on *Robinia pseudoacacia*, no voucher, *leg.* A.Š., *det.* N.M. & I.K.; **Loc. 11,** on *Alnus glutinosa*, CNF 2/418 plus one record without voucher, on *Robinia pseudoacacia* CNF 2/1961, *leg.* N.M., *det.* N.M. & I.K.; **Loc. 13**, on *Salix alba*, CNF 2/2167, *leg.* N.M. & S.G., *det.* N.M. & I.K.; Loc. 14, on *Robinia pseudoacacia*, CNF 2/4943, *leg.* H.V., *det.* N.M. & I.K.; **Loc. 15**, on *Fagus sylvatica*, CNF 2/5530, *leg.* A.B., *det.* N.M. & I.K.; **Loc. 17**, on *Sambucus nigra*, CNF 2/1671, *leg.* & *det.* N.M. & I.F.; **Loc. 18**, on *Salix* sp., CNF 2/1702, on *Alnus glutinosa*, no voucher *leg.* N.M. & Z.T., *det.* N.M. & I.K.; **Loc. 19**, on *Robinia pseudoacacia*, no voucher, *leg.* & *det.* N.M.; **Loc. 20**, on *Robinia pseudoacacia*, no voucher, *det.* N.M.; **Loc. 21**, unknown substrate, no voucher, *leg.* M.Č., *det.* N.M.; **Loc. 22**, on *Robinia pseudoacacia*, CNF 2/2994, *leg.* N.M., *det.* N.M. & I.K.; **Loc. 23**, on *Carpinus betulus*, CNF 2/4406, *leg.* N.M., *det.* N.M. & I.K.; **Loc. 25**, on *Robinia pseudoacacia* and *Corylus avellana* (no vouchers), *leg.* Lj.Đ., *det.* N.M. & I.K.; **Loc. 26**, on *Robinia pseudoacacia* (five records), CNF 2/1908, 1914, *leg.* N.M., N.M. & D.M. and Z.T. (one collection), all *det.* N.M. & I.K.; **Loc. 27**, unknown substrate, CNF 2/1724, *leg.* Z.T. & Đ.T., *det.* N.M. & I.K.; **Loc. 28**, on *Cornus sanguinea*, CNF 2/4396, 4889, 6229, *leg.* V.B., *det.* N.M. & I.K., on *Robinia pseudoacacia* no voucher, leg I.F., *rev.* N.M. & I.K.; **Loc. 29**, on *Acer campestre,* CNF 2/5547, *leg.* M.Č., *det.* N.M. & I.K.; **Loc. 31**, on *Robinia pseudoacacia*, no voucher, *det.* N.M.; **Loc. 32**, on *Robinia pseudoacacia*, CNF 2/2629, *leg.* N.M., *det.* N.M. & I.K.; **Loc. 35**, on *Picea*

abies, CNF 2/6934, *leg.* & *det.* N.M. & I.K.; **Loc. 36**, on *Picea abies*, CNF 2/4935, *leg.* N.M., on *Robinia pseudoacacia* (one record) and on *Sambucus nigra* (two records), all *det.* N.M.; **Loc. 37**, on *Sambucus nigra* no voucher, *det.* N.M.; **Loc. 38,** on *Robinia pseudoacacia* (three records), on *Sambucus nigra* (one record), no vouchers, all *det.* N.M.; **Loc. 40**, on *Populus alba*, no voucher, *leg.* & *det.* I.F., *rev.* N.M.; **Loc. 41,** on *Alnus glutinosa*, no voucher, *det.* N.M.; **Loc. 42**, on *Robinia pseudoacacia*, CNF 2/2354, on *Sambucus nigra* CNF 2/2346, *leg.* Ž.G., *det.* N.M. & I.K.; **Loc. 43**, on *Robinia pseudoacacia*, CNF 2/1658, leg N.M. & A.M, one record without vocher (obs. N.M & I.K.), both *det.* N.M. & I.K.; **Loc. 44,** on *Robinia pseudoacacia*, CNF 2/1222, 1223, *leg.* & *det.* N.M. & I.F.; **Loc. 48,** on *Sambucus nigra*, CNF 2/3260, *leg.* N.M., *det.* N.M. & I.K.; **Loc. 49**, on *Sambucus nigra* CNF 2/3265, *leg.* N.M. & M.S., *det.* N.M. & I.K.; **Loc. 50**, on *Robinia pseudoacacia*, no voucher, *det.* N.M.; **Loc. 51**, on *Robinia pseudoacacia*, no voucher, *det.* N.M.; **Loc. 53**, on *Salix caprea*, CNF 2/2373, *leg.* V.S., *det.* N.M. & I.K.; **Loc. 54**, on *Salix* sp., no voucher, *det.* N.M.; **Loc. 55**, on *Robinia pseudoacacia*, (two records), no voucher, *leg.* & *det.* N.M.; **Loc. 56,** on *Salix* sp., CNF 2/6858, *leg.* I.K., *det.* N.M. & I.K.; **Loc. 57**, on *Robinia pseudoacacia,* no voucher, *det.* N.M.; **Loc. 58**, on *Picea abies*, CNF 2/6930, *leg.* A.B. & N.M., on *Fagus sylvatica*, no voucher, *det.* N.M. & I.K.; **Loc. 60**, on *Robinia pseudoacacia*, CNF 2/2382, *leg.* V.S., *det.* N.M. & I.K.; **Loc. 61,** on *Sambucus nigra*, no voucher, *det.* N.M.; **Loc. 63**, on *Robinia pseudoacacia*, no voucher, *det.* N.M.; **Loc. 65**, on *Robinia pseudoacacia*, CNF 2/251, on *Alnus glutinosa*, CNF 2/1590 both *leg.* & *det.* N.M.; **Loc. 66**, on *Cornus sanguinea*, CNF 2/5483, *leg.* M.Č., *det.* N.M. & I.K.; **Loc. 67**, on *Prunus avium*, CNF 2/1081, *leg.* I.F., *det.* N.M. & I.K.; **Loc. 69**, on *Acer*
108 *pseudoplatanus*, CNF 2/2574, *leg.* N.M. & S.G., *det.* N.M. & I.K.; **Loc. 70**, on *Robinia pseudoacacia*, CNF 2/3291, *leg.* V.S. & N.M., *det.* N.M. & I.K.; **Loc. 71**, on *Alnus glutinosa*, CNF 2/803, 804, on Robinia pseudoacacia, CNF 2/1689, *leg.* & *det.* N.M.; **Loc. 72**, on *Sambucus nigra*, no voucher, *det.* N.M.; **Loc. 73**, on *Robinia pseudoacacia*, no voucher, *leg.* I.F., *det.* N.M.; **Loc. 74,** on fallen branch of broadleaved tree, no voucher, *leg.* & *det.* N.M. & I.F.; **Loc. 75**, unknown substrate, CNF 2/1581, *leg.* Z.T., on *Robinia pseudoacacia*, CNF 2/5484, *leg.* T.P., both *det.* N.M. & I.K., on *Robinia pseudoacacia* CNF 6/336, *leg.* M.T., *det.* HOB, publ. HOB (1984), *rev.* N.M. & I.K.; **Loc. 77**, on *Robinia pseudoacacia* (two records), on *Corylus avellana* (two records), leg N.M. (three records), M.Č. (one record), all *det.* N. M.; **Loc. 78**, on *Fagus sylvatica*, CNF 6/341, *leg.* M.T., *det.* HOB, publ. HOB (1984), *rev.* N.M. & I.K.; **Loc. 80**, on *Alnus glutinosa*, no voucher, *leg.* M.Č., *det.* N.M.; **Loc. 83**, on *Robinia pseudoacacia*, CNF 2/2618, 2620, *leg.* N.M., *det.* N.M. & I.K.; **Loc. 84**, on *Acer platanoides*, CNF 2/2366, *leg.* Ž.G., *det.* N.M. & I.K.; **Loc. 86**, on *Acer pseudoplatanus*, CNF 6/337, *leg.* M.T., *det.* HOB, publ. HOB (1984), *rev.* N.M. & I.K.; **Loc. 87**, on *Alnus incana*, CNF 2/7556, *Sambucus nigra* (one record), *leg.* V.B., on *Alnus glutinosa* (one record) *leg.* I. F., all *det.* N.M. & I.K.; **Loc. 89**, on *Fagus sylvatica*, CNF 2/7826, *leg.* N.M. & D.M., *det.* N.M. & I.K.; **Loc. 91**, on *Robinia pseudoacacia* and on *Acer campestre,* no vouchers, *det.* N.M.; **Loc. 93,** on *Alnus glutinosa*, no voucher, *det.* N.M.; **Loc. 94**, on *Alnus glutinosa*, no voucher, *det.* N.M.; **Loc. 95**, on *Robinia pseudoacacia*, CNF 6/339, *leg.* M.T., *det.* HOB, publ. HOB (1984), *rev.* N.M. & I.K.; **Loc. 96**, on *Alnus glutinosa* and on *Sambucus nigra leg.* M.Č., no voucher, det. N.M. & I.K.; **Loc. 97**, on *Sambucus nigra*, no voucher, *det.* N.M.; **Loc. 98**, on *Robinia pseudoacacia*, no voucher, det. N.M.; **Loc. 101**, on *Alnus glutinnosa,* CNF 2/2991, *leg.* N.M., det. N.M. & I.K.; **Loc. 102**, on *Cornus sanguinea*, no voucher, *det.*

N.M.; **Loc. 105**, unknown substrate, CNF 2/5527, *leg.* M.Č., *det.* N.M. & I.K.; **Loc. 106**, on *Robinia pseudoacacia* (two records) and on *Sambucus nigra* (one record), *det.* N.M.; **Loc. 109**, on *Robinia pseudoacacia*, no voucher, *leg.* I.F., *det.* N.M. & I.F.; **Loc. 110,** unknown substrata CNF 2/1444, 1666, leg Z.T., on *Robinia pseudoacacia*, CNF 2/545 plus two records with no voucher, *leg.* I.F. on *Salix* sp., CNF 2/1218, *leg.* N.M. & Z.T., on *Sambucus nigra* no voucher (one record), all *det.* N.M. and N.M. & I.K.; **Loc. 111**, on *Acer* sp., no voucher, *det.* N.M. & I.K.; **Loc. 113**, on *Sambucus nigra*, two records, no voucher, *det.* N.M.; **Loc. 116**, on *Sambucus nigra*, CNF 2/3665, 3 *leg.* N.M. & D.M., *det.* N.M. & I.K.; **Loc. 118**, on *Robinia pseudoacacia*, CNF 2/1656 (monitored fructification!) plus one record without voucher, on *Sambucus nigra* CNF 2/1677, *leg.* & *det.* N.M.; **Loc. 119,** CNF 6/342, *leg.* Č.Š., *det.* HOB, publ. HOB (1984), *rev.* N.M. & I.K. **Loc. 120,** on *Oreoherzogia fallx*, CNF 2/3085, *leg.* N.M. & D.M., *det.* N.M. & I.K., on *Salix* sp. and on *Acer pseudoplatanus*, no vouchers, *det.* N.M.; **Loc. 121**, on *Alnus glutinosa* and on *Robinia pseudoacacia* no vouchers, *det.* N.M.; **Loc. 123**, on *Sambucus nigra*, no voucher, *det.* N.M.; **Loc. 124**, on *Acer pseudoplatanus*, CNF 2/2218, *leg.* N.M. & D.M., *det.* N.M.; **Loc. 126,** on *Robinia pseudoacacia*, exs.: CNF 2/2347, 2999, *leg.* Ž.G., *det.* N.M. & I.K.; **Loc. 127**, on *Quercus petraea*, CNF 2/5526, *leg.* M.Č., *det.* N.M. & I.K.; **Loc. 128**, on *Alnus glutinosa*, CNF 2/1949, *leg.* N.M., *det.* N.M. & I.K.; **Loc. 129**, on *Sambucus nigra*, CNF 2/1662, *leg.* N.M. & Z.T., *det.* N.M.; **Loc. 130**, on *Robinia pseudoacacia*, CNF 2/5486, *leg.* V.B., *det.* N.M. & I.K.; **Loc. 132**, on *Sorbus aria*, CNF 2/2384, *leg.* V.S., *det.* N.M. & I.K.; **Loc. 134**, on *Fraxinus ornus*, CNF 2/6897, *leg.* M.Č., *det.* N.M. & I.K.; **Loc. 135**, on *Robinia pseudoacacia*, CNF 2/101, *leg.* & *det.* N.M.; **Loc. 136**, on *Sambucus nigra*, no voucher, *det.* N.M.; **Loc. 137**, on *Alnus glutinosa*, no voucher, *det.* N.M.; **Loc. 138**, on *Sambucus nigra*, CNF 2/3298, *leg.* V.S. & N.M., *det.* N.M. & I.K.; **Loc. 139**, on *Robinia pseudoacacia*, no voucher, *det.* N.M.; **Loc. 140**, on *Robinia pseudoacacia*, CNF 2/95, 1207, *leg.* & *det.* N.M.; **Loc. 141**, on *Prunus avium,* CNF 2/6850, *leg.* C.S., N.M. & I.K., *det.* N.M. & I.K., publ N.M. *et al* (2005).

Sarcoscypha coccinea (Scop. : Fr.) Lambotte

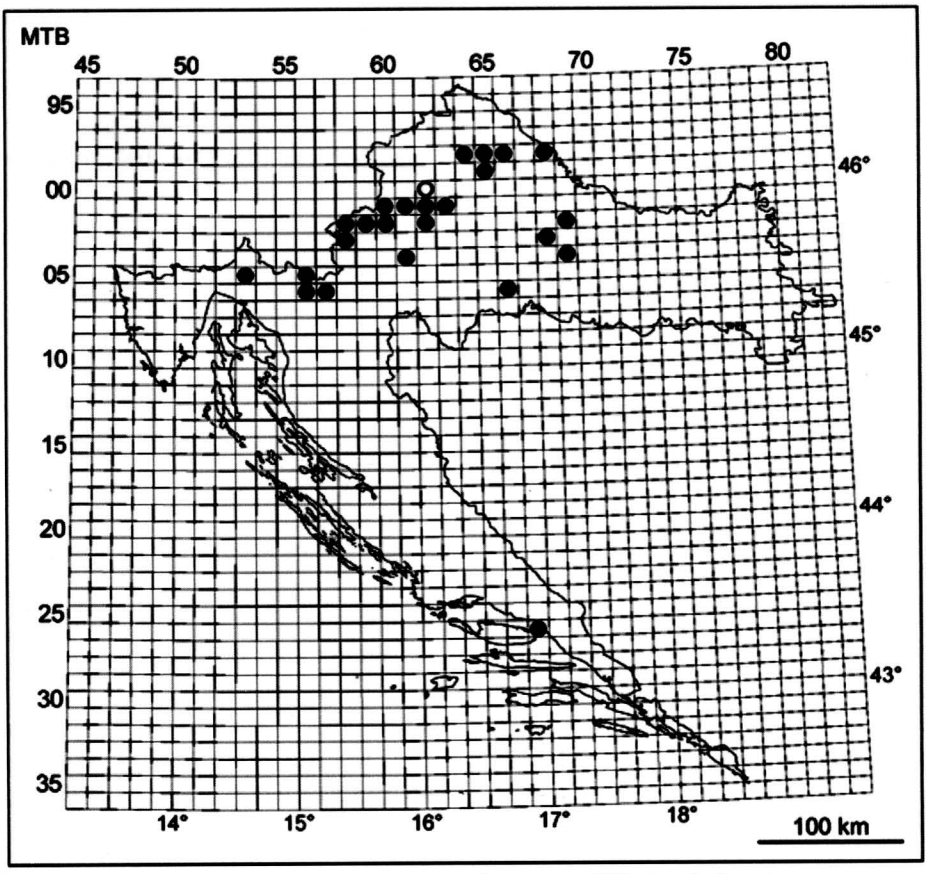
Occurence and distribution

This species is fairly frequent and very widely distributed. In Croatia it is spread from Mediterranean mixed evergeen/deciduous forests through almost all major habitat forest types of continental planar and colline zones to the highest forest stands in subalpine zone. However, the species has sharp distribution peak in the colline to montane zone in deciduous forests rich in *Carpinus betulus, Corylus avellana* and *Fagus sylvatica*. There are four tree species revealed as apparently new hosts for *S. coccinea* (Fig. 7): *Quercus ilex* in mesomediterranean area, *Ostrya carpinifolia* in subthermophilic continental deciduous forests, *Sorbus aria* in calciphilous montane deciduous forests and *Juglans regia* in orchards. The species is found as low as 90 m s. m. in Posavina lowland to 1400 m s. m. in the subalpine forest below Risnjak peak (1528 m).

Specimens examined

Loc. 6, on *Carpinus betulus* three records without voucher, *det.* N.M.; **Loc. 7**, on *Corylus*

avellana, CNF 2/3290, *leg.* V.S., *det.* N.M. & I.K.; **Loc. 8**, on *Corylus avellana*, CNF 2/1659, *leg.* N.M. & Z.T., *det.* N.M. & I.K.; **Loc. 9**, on *Fagus sylvatica*, CNF 2/4862, *leg.* & *det.* N.M.; **Loc. 12**, on *Salix* sp., no voucher, *det.* N.M.; **Loc. 16,** on *Carpinus betulus*, CNF 6/340, *leg.* M.T., *det.* HOB, publ. HOB (1984), *rev.* N.M. & I.K. **Loc. 24**, on *Carpinus betulus*, CNF 2/3234 plus one record without voucher, on *Fagus sylvatica* (two records without voucher) *leg.* N.M. & D.M., *det.* N.M. & I.K.; **Loc. 28**, on *Prunus domestica*, CNF 2/6215, *leg.* V.B., *det.* N.M. & I.K.; **Loc. 30,** on *Fraxinus angustifolia*, CNF 2/4141, *leg.* N.M. & *det.* N.M.; **Loc. 32**, on *Juglans regia*, CNF 2/2986, *leg.* Ž.G., *det.* N.M. & I.K.; **Loc. 33**, on *Fagus sylvatica,* CNF 2/3268, *leg.* N.M. & D.M., *det.* N.M. & I.K. **Loc. 34**, unknown substrate, CNF 6/334, *leg.* S.H., *det.* HOB, publ. HOB (1984), *rev.* N.M. & I.K.; **Loc. 45**, on *Carpinus betulus*, no voucher, *det.* N.M.; **Loc. 46**, on *Carpinus*, CNF 2/99, *leg.* & det, N.M.; **Loc. 47**, on *Corylus avellana*, CNF 2/3204, on *Carpinus betulus*, no voucher, *leg.* N.M. & D.M., *det.* N.M. & I.K.; **Loc. 49**, on *Salix* sp. CNF 2/3264, *leg.* N.M. & M.S., *det.* N.M.; **Loc. 55**, on *Carpinus betulus*, CNF 2/2167, *leg.* N,M. & S.G., *det.* N.M. & I.K.; **Loc. 59,** on *Carpinus betulus*, CNF 2/1206, *leg.* & *det.* N.M.; **Loc. 62**, on *Ostrya carpinifolia*, CNF 2/3674, *leg.* N.M. & D.M., *det.* N.M. & I.K.; **Loc. 63,** on *Carpinus betulus*, CNF 2/1680. leg N.M. & D.M. plus two records with no voucher, *det.* N.M.; **Loc. 64,** on *Corylus avellana*, CNF 2/2985, *leg.* N.M. & D.M., *det.* N.M. & I.K.; **Loc. 66**, unknown substrate, CNF 2/41, *leg.* I.F., *det.* N.M. & I.K.; **Loc. 75**, fallen branch of broadleaved tree, CNF 2/1446, 1448, *leg.* Z.T., *rev.* N.M. & I.K.; **Loc. 76**, on *Quercus petraea*, CNF 2/1445, *leg.* Z.T., *det.* N.M. & I.K.; **Loc. 80**, on *Corylus avellana*, no voucher, *leg.* M.Č., *det.* N.M.; **Loc. 81**, on *Quercus ilex*, CNF 2/7375,
110 *leg.* M.C., *det.* N.M. & I.K.; **Loc. 82**, on *Carpinus betulus*, no voucher, *det.* I.F.; **Loc. 83**, on *Robinia pseudoacacia*, CNF 2/2330, *leg.* Ž.G., *det.* N.M. & I.K.; **Loc. 84**, on *Carpinus betulus*, CNF 2/2367, 2369, on *Fagus sylvatica*, CNF 2/2364, *leg.* Ž.G., *det.* N.M. & I.K.; **Loc. 85**, on *Fraxinus excelsior*, no voucher *det.* N.M.; **Loc. 88,** on *Corylus avellana,* no voucher, *det.* N.M.; **Loc. 90**, unknown substrate, CNF 6/335, *leg.* M.T., *det.* HOB, publ. HOB (1984), *rev.* N.M. & I.K. **Loc. 92**, unknown substrate, CNF 2/1913, *leg.* M.S., *det.* N.M. & I.K.; **Loc. 99**, *Fagus sylvatica*, CNF 6/338, *leg.* M.T., *det.* HOB, publ. HOB (1984), *rev.* N.M. & I.K. **Loc. 100,** on *Corylus avellana,* CNF 2/2383, *leg.* V.S., *det.* N.M. & I.K.; **Loc. 103**, on *Salix* sp., CNF 2/5485, *leg.* M.Č., *det.* N.M. & I.K.; **Loc. 104,** on *Corylus avellana,* , *leg.* I.F., no voucher, *det.* N.M. & I.F.; **Loc. 110,** unknown substrata CNF 2/1588, leg Z.T., *det.* N.M. & I.K.; **Loc. 112**, on *Prunus domestica*, CNF 2/6218, *leg.* M.Č., *det.* N.M. & I.K.; **Loc. 114**, on *Carpinus betulus*, CNF 2/6908, *leg.* N.M. & D.M., *det.* N.M. & I.K.; **Loc. 115**, on *Carpinus betulus*, CNF 2/3284, *leg.* N.M. & V.S., *det.* N.M. & I.K.; **Loc. 121**, on *Carpinus betulus*, CNF 2/96, 811 *leg.* & *det.* N.M.; **Loc. 122**, on *Carpinus betulus,* no voucher, *det.* N.M.; **Loc. 125**, on *Corylus avellana*, no voucher, *det.* N.M.; **Loc. 129**, on *Quercus petraea*, CNF 2/2358, *leg.* V.S., *det.* N.M. & I.K.; **Loc. 130**, on *Carpinus betulus,* no voucher, *det.* I.F.; **Loc. 131**, on *Sorbus aucuparia* and *Fagus sylvatica*, CNF 2/2217 (mixed collection!), *leg.* N.M. & D.M., *det.* N.M. & I.K.; **Loc. 133,** on *Prunus* sp., CNF 6/333, *leg.* S.T., *det.* HOB, publ HOB (1984), *rev.* N.M. & I.K.; **Loc. 140**, on *Rubus* sp., CNF 2/410, *leg.* N.M., *det.* N.M. & I.K.



Map 2 Known distribution of *S. coccinea* (filled circles) and *S. coccinea* with *S. jurana* (empty circle) in Croatia.

Sarcoscypha jurana (Boud.) Baral

OCCURENCE AND DISTRIBUTION

This species is quite rare in Croatia and it is not surprising as it has the narrowest substrate range of all species concerned. It is confined only to the rotten branches of *Tilia*. *Tilia* species has generally very low frequency in Croatian natural and seminatural habitats. Montane calciphilous relict *Tilio-Taxetum* forests (*T. platyphyllos*), Pannonic forests of pedunculate oak and common hornbeam with *Tilia tomentosa* (RAUŠ & *al.* 1992) and mediterranoid calciphilous continental *Tilio-Quercetum dalechampii* stands (*T. cordata*, BERTOVIĆ & LOVRIĆ 1987) are the only significant forest types in Croatia that contain higher portion of *Tilia* species and they all occupy very small areas. Another habitat with significant portion of *Tilia platyphyllos* are town parks in the continental area of Croatia.

Town parks with *Tilia* species and *Tilio-Taxetum* stands in vicinity of Zagreb have been intensively researched during last 15 years with the single collection of *S. jurana* found in *Tilio-Taxetum* stand on the eastern part of Mt. Medvednica (Map 2). *Tilio-Quercetum dalechampii* stands are under ongoing research, while pedunculate oak and common hornbeam forest

with *Tilia tomentosa* is not covered with the research yet. The species is recorded in Croatia for the first time.

SPECIMENS EXAMINED

Loc. 68, on *Tilia* sp., CNF 2/2385, *leg.* V.S., *det.* N.M. & I.K; **Loc. 107**, on *Tilia* sp., CNF 2/2714, *leg.* anonymous, *det.* I.F., *rev.* N.M. & I.K.

Sarcoscypha macaronesica Baral et Korf

OCCURENCE AND DISTRIBUTION

This species has clear Mediterranean distribution and its occurence is confined to tall, more or less purely evergreen forests dominated by *Quercus* and/or *Laurus* species on Croatian islands and small peninsulas of Dalmatia (Korčula, Brač and Lapad). It is so far known only from five localities (Map 1).

NOTES

The species is here recorded for Croatia for the first time since FOCHT (1986) did not specified neither the locality nor the material on which he based his short notes on the species. The existence of exsiccata of *S. macaronesica* in his material is confirmed in this research. He collected the species in former luxuriant evergreen forest (subsequently vanished under intensive urbanization) in the Dubrovnik area. The species is generally considered as threatened in Croatia and therefore included in Red List of Fungi of Croatia (TKALČEC, MEŠIĆ & MATOČEC 2005).

SPECIMENS EXAMINED

Loc. 1, on *Laurus nobilis*, CNF 2/136, *leg.* I.F., *det.* I.F., not adequately publ. for Croatia (1986), *rev.* N.M. & I.K.; **Loc. 52**, on *Laurus nobilis*, CNF 2/6396, *leg.* N.M., *det.* N,M. & I.K..; Loc. 79, on *Quercus ilex*, CNF 2/6115, *leg.* A.S. & N.M., *det.* N.M. & I.K.; **Loc. 108**, on *Quercus ilex*, CNF 2/6132, *leg.* M.C., *det.* N.M. & I.K.; **Loc. 117**, on *Quercus ilex*, CNF 2/6184, *leg.* M.C., N.M. & I.K., *det.* N.M. & I.K.

DISCUSSION

Species frequency and biogeography

All three special studies undertaken so far on European *Sarcoscypha* species, one for Central Europe and Western Mediterranean area (BARAL 1984), another in South-eastern Austria (PIDLICH-AIGNER 1999) and the present one, carried out in Croatia confirmed *S. austriaca* as most frequent species. It has almost two times higher frequency than *S. coccinea* in Central Europe (BARAL 1984), more than 2,5 times higher frequency in Croatia and has over seven times higher frequency in Styria (PIDLICH-AIGNER 1999), see Fig. 3. It is widespread species, but with more or less continental to Baltic main distribution and is seemingly absent or very rare in warm Atlantic-Mediterranean zone (see distribution map in BARAL, 1984).

However, *S. coccinea* is far from being rare, occupying wide areas along the Europe, from warm Atlantic-Mediterranean zone to the Baltic and Central European continental regions. Two remaining species are much rarer or fairly limited in distribution. *S. jurana* is obviously quite common in the Continental Europe from Northern carbonate Alpine belt and Tatra mountains northwards (BARAL 1984).

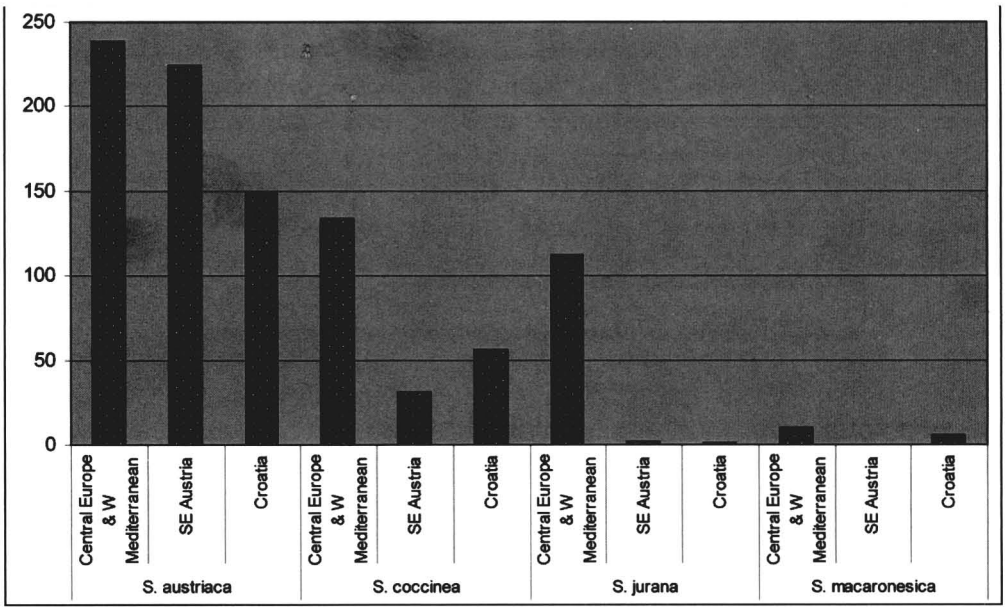


Fig. 3 European *Sarcoscypha species* frequencies after three separate studies (bar height represents collections with known substrata): Central Europe and Western Mediterranean (BARAL 1984), South-eastern Austria (PIDLICH-AIGNER 1999) and Croatia (this paper).

Two studies that covered area South-eastern from the central Alpine ridge showed that this species is apparently rare there. A number of aimed field trips undertaken in Croatian habitats likely to house the species resulted only with a single collection. On the other hand, *S. macaronesica* is confined to Mediterranean areas with full grown tall evergeeen forests of *Quercus* and *Laurus* species. It seems that this species has rather low frequency even under its optimal areas. Species frequencies are summarized in Fig. 3.

Fructification dynamics and vertical distribution

Our data on apothecial development and sporulation season largely correspond with those of PIDLICH-AIGNER (1999). Apothecia of *S. austriaca* found in autumn are rare, and they are always immature. In such cases apothecia are overwintered and can hardly sporulate before February. On the contrary, there are number of mature apothecia of *S. coccinea* found from late October to the end of December. The peak of the fructification period of the species falls in mid February, while in *S. austriaca* falls in March to April (Fig. 4). Differences between two species in montane to subalpine areas (localities approx. above 500 m s. m.) are slightly lesser, where one can found ripe apothecia of both species from March to May due

to colder climate (not shown). *S. macaronesica* have narrowed fructifying period that falls mainly in mid winter when heavy rain occur in its Mediterranean habitats. Two collections found in March and April were overmature and highly decayed.

Although both *S. austriaca* and *S. coccinea* are vertically widely distributed (i.e. present in all vertical classes) they show considerable differentiation (Fig. 5). *S. austriaca* has highest fequency in planar lowland (0-140 m class) dominated by flood forest types and in colline belt (140-400 m class), while *S. coccinea* has maximal frequency in colline to montane belts (400-800 m). We cannot ascertain the situation in altimontane and subalpine areas because they are presently still underexplored in comparison to the lower areas with the lower altitude in Croatia.

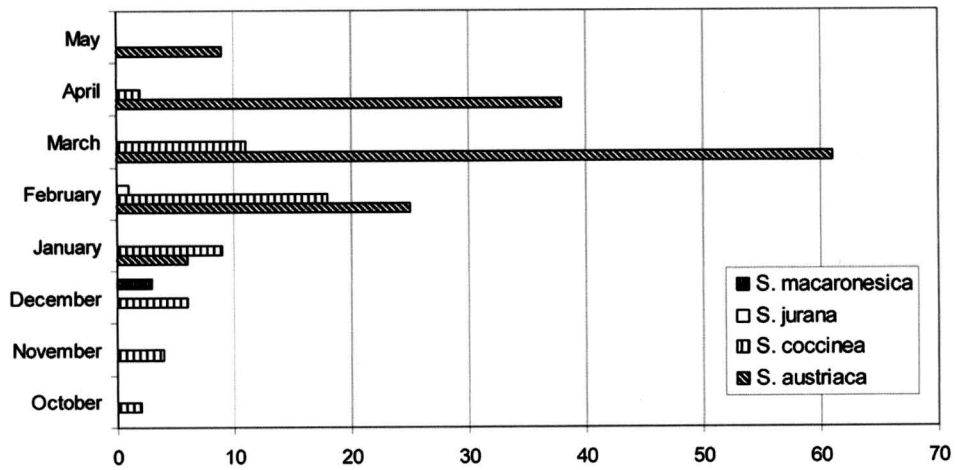


Fig. 4 Apothecial maturation dynamics in Croatian *Sarcoscypha* species. Collections containing immature and decayed old apothecia were not taken into account, as well as those found above 500 m s. m.

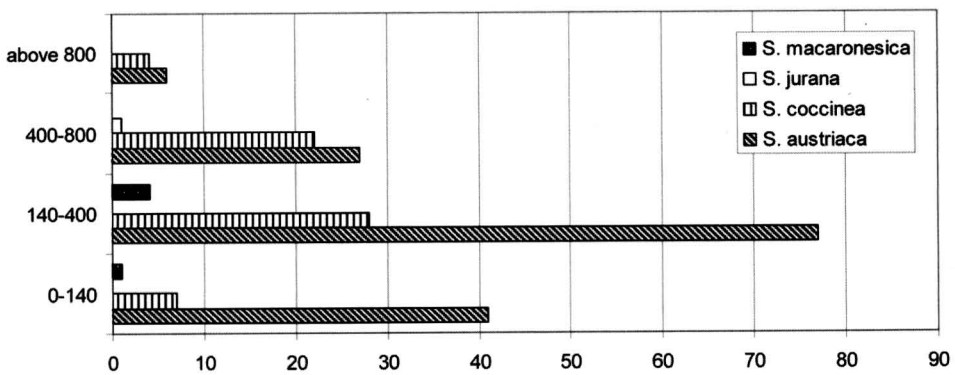


Fig. 5 Vertical distribution of the Croatian *Sarcoscypha* species.

Substrate preferences

Data summarized in Fig. 6 clearly show differencies in substrate preference in all *Sarcoscypha* species with the *Salix* branches being the only substrate type with similar preference shared between *S. austriaca* and *S. coccinea*. Dead branches of evergreen trees

(*Quercus* spp. and *Laurus* spp.) are almost exclusively occupied by *S. macaronesica* and *Tilia* branches by *S. jurana*. Fallen branches of deciduous ulmacean, rosacean and fagalean species (except *Betulaceae*), especially those from genera *Fagus, Corylus, Carpinus, Ulmus* and *Prunus* are the main substrata for *S. coccinea*. To the contrary, *S. austriaca* colonize mainly aceracean, betulacean, salicacean, caprifoliaceaen and fabacean woody substrata (mainly from genera *Alnus, Robinia, Acer, Salix* and *Sambucus*).

Our study resulted in some new substrate type records for certain species (Fig. 6, 7). Most important revealed new host is *Sambucus nigra*, which is one of the main substrates for *S. austriaca* in planar to colline biotopes of Croatia. Seems it is recorded here for the first time and, together with *Robinia pseudoacacia* makes most frequent habitat as these two plant species are frequently found together in spontaneous association in lowland to colline Croatia where original vegetation is disturbed or degraded. *Picea abies* branches are also newly recorded substrate on which *S. austriaca* is repeatedly found. Together with Perić's data on Montenegrin *Sarcoscypha* species (another article, this volume), this species is recorded on coniferous substrate for the first time.

		Laurus	Quercus (evergreen)	Quercus (deciduous)	Tilia	Corylus	Carpinus	Fagus	Ulmus	Rosaceae (woody)	Salix	Alnus	Robinia	Acer	Sambucus
S. austriaca	Baral	0	0	0	0	5	0	1	1	1	55	94	39	41	0
	Pidlich-Aigner	0	0	0	0	1	0	0	1	0	49	122	22	29	0
	This paper	0	0	1	0	4	1	5	0	3	9	19	66	8	22
S. coccinea	Baral	0	0	1	1	9	7	48	21	29	7	1	2	2	0
	Pidlich-Aigner	0	0	0	0	23	0	1	1	0	6	0	0	0	0
	This paper	0	1	2	0	9	23	8	0	5	3	0	1	0	0
S. jurana	Baral	0	0	0	112	0	0	0	0	0	0	0	0	0	0
	Pidlich-Aigner	0	0	0	2	0	0	0	0	0	0	0	0	0	0
	This paper	0	0	0	1	0	0	0	0	0	0	0	0	0	0
S. macaronesica	Baral	9	0	0	0	0	0	0	0	1	0	0	0	0	0
	Pidlich-Aigner	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	This paper	2	3	0	0	0	0	0	0	0	0	0	0	0	0

Fig. 6 Main substrate type frequencies (marked in grey field) in European species of *Sarcoscypha* after three separate studies (numbers indicate collection quantities). Bolded numbers designate frequency above 25% of total collections per each study; while normal number in grey field designate their frequency 10-25% of total collections.

Spatial relations among species

The species *S. coccinea, S. jurana* and *S. macaronesica* are not found to occur together in any particular locality in Croatia so far and they can be regarded as spatially separated. On the

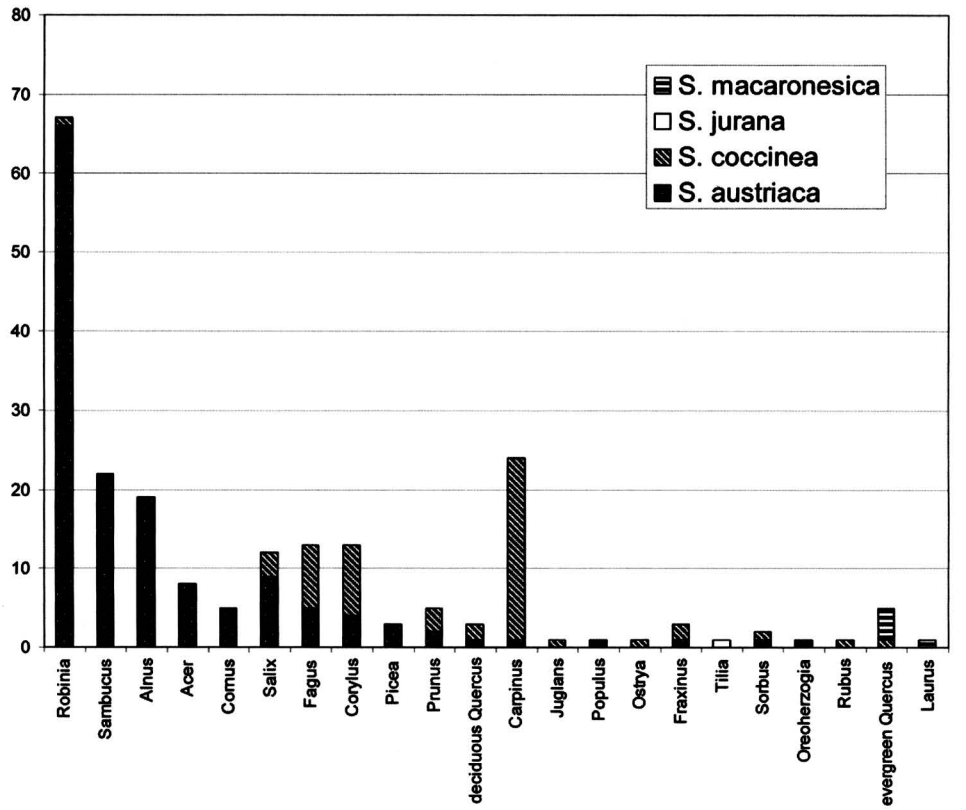


Fig. 7 Substrate type frequencies Croatian species of *Sarcoscypha* (bar height represents collections quantity).

other hand, there are many localities in which *S. austriaca* and *S. coccinea* were repeatedly found together (Fig. 8). However, these two species were never found together on the same substratal unit. Similar situation occur in Austria (PIDLICH-AIGNER 1999).

Habitat preferences

When we take into account only natural habitat types in Croatia, *Sarcoscypha coccinea* and *S. austriaca* have their population contact only in lowland ground water dependent forests and in subalpine stands. According the Fig. 9 we can suppose that *S. austriaca* became significantly more spread and its frequency have been considerably increased when *Robinia pseudoacacia* was introduced from North America and later extensively spread along Croatian continental lowland by man in past few centuries. Under these circumstances *S. austriaca* and *S. coccinea* might came in significantly wider population contact. Other species are apparently in negligible spatial contact as they inhabit different biotopes.

In comparison to the other special research done on European *Sarcoscypha* species, there is general agreement in species habitat type preferences (cf. DARAL 1984, PIDLICH-AIGNER 1999).

The main habitats of *S. austriaca* indicated in all three studies are either deciduous forests dependent on high level regime of both ground and flood water, regardless of vertical

	S. austriaca			
S. jurana	0	82	16	S. coccinea
	1	0/0	32	
	0	5	0	
	S. macaronesica			

Fig 8 Croatian localities exclusively settled with single *Sarcoscypha species* (middle rows/columns) and those settled with a pair of species (corner fields and the central one).

	S. austriaca			
S. jurana	(calciphilous montane deciduous forest rich in *Tilia*)	*Robinia-Sambucus* stands, colline deciduous forest rich in *Sambucus*, montane deciduous forest rich in *Acer*	colline often heavily degraded deciduous forest and *Prunus* orchards invaded by *Robinia*, city parks *Alnus-Salix* riparian forest, *Fraxinus* and *Populus* flood forest, altimontane mixed forest	S. coccinea
	calciphilous montane deciduous forest rich in *Tilia*	(calciphilous montane deciduous forest rich in *Tilia* for **cocc.-jur.**)/ none for **aus.-mac.**	colline to montane deciduous and mixed *Abies* forest, orchards without *Robinia* and/or *Sambucus*	
	none	humid evergreen *Quercus-Laurus* forest	semideciduous forest with *Quercus ilex*	
	S. macaronesica			

Fig. 9 Croatian main habitat types specific to each *Sarcoscypha species* (middle rows/columns) and their main mutual habitats (corner fields and the central one). Possible mutual habitats are given in parentheses. Anthropogenous habitats are marked with grey.

zones (habitats with domination of all three *Alnus* species - *A. glutinosa, A. incana* and *A. viridis*; *Salix* species), anthropogenous stands dominated by *Robinia pseudoacacia* or *Robinia* inclusions in various types of deciduous forests in planar to colline zone, and deciduous altimontane to subalpine forests w ith high frequency of *Acer* species. *S. coccinea* is most frequent in colline to montane deciduous and mixed forests dominated by *Fagus sylvatica* accompanied with *Carpinus betulus* and/or *Corylus avellana* and to lesser degree, in lowland forests rich in *Ulmus* and *Salix*. To the contrary, ecologically two far more stenovalent species occur in few habitat types. *S. macaronesica* is confined to evergeen Mediterranean forests dominated with sclerophyllic *Quercus* and/or *Laurus* species, while *S. jurana* is confined to the deciduous montane forests rich in *Tilia* species.

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